

ICHTHYOLOGY.—*Three new species of archibenthic iniomous fishes from the western North Atlantic.* GILES W. MEAD, United States Fish and Wildlife Service.

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The species discussed below are represented by specimens caught in moderately deep water by the United States Fish and Wildlife Service vessels *Oregon* and *Silver Bay*, the Harvard-Havana Expedition of the *Atlantis*, and by several small older collections in the United States National Museum, the Chicago Natural History Museum, and the Museum of Comparative Zoology, Harvard University.

I wish here to express my appreciation to those who, by supplying specimens for study and information about others, have contributed to this account: Dr. N. B. Marshall (British Museum); Loren P. Woods and Mrs. Marion Grey (Chicago Natural History Museum); William C. Schroeder and Mrs. Myvanwy M. Dick (Museum of Comparative Zoology, Harvard University); and Dr. Charles R. Robins (Marine Laboratory, University of Miami). My thanks also go to the scientific staff and crew of the M/V *Oregon*, particularly to Harvey R. Bullis, Jr., and Warren F. Rathjen of the United States Fish and Wildlife Service, for their hospitality and assistance while at sea and for their continued interest in the progress of work later based on the collections obtained by their vessels.

***Chlorophthalmus brasiliensis*, n. sp.**

Figs. 1, 2

The description which follows is based on specimens collected by the U. S. Fish and Wildlife Service vessel *Oregon* during its exploration of the coastal shelf of northeastern South America (cruise 47; November 1957). This cruise made several deep-water stations between Venezuela and the Equator, and fortunately these contained representatives of the more northern *Chlorophthalmus agassizi* as well as large series of the form described below as new. Since I plan to review the infraspecific variability in western North Atlantic *C. agassizi* in a later paper, I will restrict my remarks here to a comparison of the new species, from off

Northern Brazil, with the geographically adjacent population of *C. agassizi*. Except for the long-nosed greeneye, *Parasudis truculentus*, no other species of chlorophthalmid is known from the western North Atlantic.

Holotype.—A specimen 117.0 mm in standard length from *Oregon* station 2082 (see data in table): U.S.N.M. no. 156892.

Paratypes.—371 specimens from the following *Oregon* stations; all off northern Brazil.

2080 02°04'N.lat. 47°00'W.long. 125 fms. Nov. 17, 1957
2081 01°52'N.lat. 46°54'W.long. 175 fms. Nov. 17, 1957
2082 01°51'N.lat. 46°50'W.long. 200 fms. Nov. 17, 1957
2083 01°49'N.lat. 46°48'W.long. 225 fms. Nov. 17, 1957
2084 01°45'N.lat. 46°46'W.long. 275 fms. Nov. 18, 1957

TABLE 1.—FREQUENCY DISTRIBUTION OF NUMBER OF ANAL FIN RAYS, GILL RAKERS, AND PRE-DORSAL SCALES IN SAMPLES OF *Chlorophthalmus brasiliensis* FROM OFF BRAZIL AND OF *C. agassizi* FROM SIMILAR DEPTHS OFF VENEZUELA AND THE GUIANAS.

| | Anal fin rays | | | |
|-------------------------------------|---------------|----|----|----|
| | 7 | 8 | 9 | 10 |
| <i>C. brasiliensis</i> (Brazil) | | 9 | 40 | 1 |
| <i>C. agassizi</i> (Surinam) | | 4 | | |
| <i>C. agassizi</i> (British Guiana) | 3 | 11 | | |
| <i>C. agassizi</i> (Venezuela) | 1 | 12 | | |

| | Gill rakers | | | | | | | | | | | | | |
|-------------------------------------|-------------|----|---|------------|----|----|----|----|-------|----|----|----|----|----|
| | Upper limb | | | Lower limb | | | | | Total | | | | | |
| | 2 | 3 | 4 | 19 | 20 | 21 | 22 | 23 | 22 | 23 | 24 | 25 | 26 | 27 |
| <i>C. brasiliensis</i> (Brazil) | | 41 | 9 | | 7 | 28 | 12 | 3 | | 7 | 25 | 12 | 5 | 1 |
| <i>C. agassizi</i> (Surinam) | 2 | 2 | | 2 | 2 | | | | 4 | | | | | |
| <i>C. agassizi</i> (British Guiana) | 1 | 13 | | 3 | 9 | 2 | | | 4 | 8 | 2 | | | |
| <i>C. agassizi</i> (Venezuela) | | 13 | | 6 | 3 | 4 | | | 6 | 3 | 4 | | | |

| | Predorsal scales | | | | |
|-------------------------------------|------------------|----|----|----|----|
| | 11 | 12 | 13 | 14 | 15 |
| <i>C. brasiliensis</i> (Brazil) | | 6 | 26 | 14 | 4 |
| <i>C. agassizi</i> (Surinam) | 1 | 2 | 1 | | |
| <i>C. agassizi</i> (British Guiana) | 3 | 10 | 1 | | |
| <i>C. agassizi</i> (Venezuela) | 3 | 10 | | | |

Most of these specimens have been deposited in the U. S. National Museum (U.S.N.M. nos. 159358 to 159362). Others are in the collections of the Chicago Natural History Museum; Museum of Comparative Zoology, Harvard University; Academy of Natural Sciences of Philadelphia; Natural History Museum, Stanford University; University of Miami Marine Laboratory; British Museum (Natural History); Rijksmuseum van Natuurlijke Historie, Leiden; and the Stichting Surinaams Museum, Paramaraibo.

Diagnosis.—The terete form, circular eye of moderate size, and prolonged tip of lower jaw will distinguish *C. brasiliensis* from *C. agassizi*, the highly variable species to which I refer not only all western North Atlantic specimens which I have seen (including *C. chalybeius* Goode) but also the tropical west African *C. atlanticus* Poll. *C. agassizi* is composed of several allopatric infraspecific populations, and it will be most useful here to compare it to the population geographically nearest to it. A summary of the most apparent characters by which the two forms can be distinguished follows:

| <i>Chlorophthalmus agassizi</i> , FROM OFF VENEZUELA AND THE GUIANAS | <i>Chlorophthalmus brasiliensis</i> , FROM OFF NORTHERN BRAZIL |
|--|---|
| 1. Diameter of orbit greater than 40 percent of prepectoral length. | 1. Diameter of orbit less than 40 percent of prepectoral length. |
| 2. Length of snout, in percent of prepectoral length, less than $(23.37 + 0.189 \text{ times prepectoral length})$. | 2. Length of snout, in percent of prepectoral length, greater than $(23.37 + 0.189 \text{ times prepectoral length})$. |
| 3. Postorbital width of head, in percent of prepectoral length, greater than $(43.7 + 0.184 \text{ times prepectoral length})$. | 3. Postorbital width of head, in percent of prepectoral length, less than $(43.7 + 0.184 \text{ times prepectoral length})$. |
| 4. Length of pectoral fin, in percent of standard length, greater than $(24.2 + 0.009 \text{ times standard length})$. | 4. Length of pectoral fin, in percent of standard length, less than $(24.2 + 0.009 \text{ times standard length})$. |
| 5. Anal fin rays modally $8\frac{1}{2}$. | 5. Anal fin rays modally 9. |
| 6. Total number of gill rakers (both limbs) modally 23. | 6. Total number of gill rakers (both limbs) modally 24. |
| 7. Number of predorsal scales modally 12. | 7. Number of predorsal scales modally 13. |

Description.—The proportional measurements which follow are expressed in percent of standard length and are those of the type, 117.0 mm in standard length, followed, in parentheses, by the range of values found in a series of 20 paratypes, 93.7 to 132.0 mm in length:

Length of head, 30.1 (28.7–31.4); width of head, measured between the posterior midpoints

of the orbits, 14.1 (13.5–14.6); width of head, measured between the anterior midpoints of the orbits, 10.8 (10.1–11.5). Width of body, measured immediately behind the bases of the pectoral fins, 12.9 (11.5–13.5). Depth of body, at origin of dorsal fin, 16.0 (14.2–16.0); at origin of anal fin, 10.9 (10.0–12.2); at origin of adipose fin, 10.0 (8.4–10.6); least depth of caudal peduncle, 7.0 (6.6–7.6).

Length of snout, 9.4 (9.0–10.0); length of upper jaw, 13.1 (12.3–13.7); distance from snout to tip of lower jaw (mouth closed), 2.5 (2.2–2.6). Horizontal diameter of orbit, 10.9 (10.1–11.4); width of bony interorbital, 2.7 (2.7–3.1).

Distance from snout to origin of dorsal fin, 36.2 (35.4–37.8); preanal distance, 75.7 (74.5–81.3); prepectoral length, 29.2 (28.1–31.5); pre-ventral distance, 40.8 (39.6–42.6). Length of base of dorsal fin, 10.7 (10.3–12.2); of anal fin, 7.3 (6.6–8.0). Length of pectoral fin, 22.8 (22.0–24.7); of ventral fin, 17.9 (17.6–20.0). Depressed height of dorsal fin, 20.1 (19.7–23.2); of anal fin, 13.6 (13.5–15.7). Length of upper lobe of caudal fin, measured from the base of the first upper procurrent caudal ray, — (23.5–26.6).

D.—11. A.—9 (occasionally 8 or 10). P.—16–17. V.—9. C.—I-17-I. Gill rakers (lower limb of anterior arch)—20–23 (usually 21); total gill raker count (first arch)—23–26 (modally 24). Scales in horizontal series (between the upper point of the gill opening and the base of the midcaudal ray)—51–56. Scales between anus and origin of anal fin—18–21; predorsal scales—13–14; scale rows between origin of dorsal fin and lateral line—7–8.

Body terete, nearly circular in cross-section anteriorly but becoming compressed posteriorly. Depth of body, at dorsal origin, 1.9–2.2 in length of head. Width of body, immediately behind insertion of pectoral fin, 2.3–2.8 in length of head. Length of head 3.2–3.5 in standard length.

Body and suborbital region of head covered with imbricate, weakly denticulated cycloid scales most of which are usually lost during capture. Lateral line scales pierced by a tube but otherwise similar to body scales. No prominent axillary scales; those surrounding pelvic base and those in and below the axil of the pectoral fin somewhat larger than body scales and variously shaped.

Head broadest immediately behind eye; sides of head converging evenly forward to the

rounded snout. Tip of snout on a horizontal with center of eye and with tip of lower jaw, when the mouth is closed. Length of snout 1.1–1.2 in diameter of orbit. Lower jaw terminal, ending in a horizontal triangular plate. This mandibular extension (snout to tip of lower jaw with mouth closed) 3.5–4.2 in length of snout. Angle of gape just before a vertical from anterior edge of orbit. Maxillary ending below anterior edge of pupil. Posterior two-thirds of maxillary surmounted by a long and slender supramaxillary. Maxillary broad posteriorly, its rear edge convex and sloping downward, forward and inward.

Head covered by an extensive network of sensory pores which cannot be described satisfactorily because of the loss of skin which has occurred in almost all specimens. This system is most highly developed on the interorbital region. Particularly evident are the pores which extend onto the dermal dorsal eyelid, the circum-orbital system, and the scattered series of pores on the ventral surface of the head.

Teeth present on premaxillary, dentary, palatine and vomer. Tongue, the tip of which is free, is edentulous. The terminal part of the lower jaw, which extends beyond the upper, bears a pair of toothed patches lateral to the edentulous median symphyseal ridge. These teeth are small, bristlelike and depressible. These patches are not continuous with the principal series of mandibular teeth. The extreme tip of the lower jaw, distal to the symphyseal ridge with its adjacent tooth patches, bears no teeth and is pierced by a pair of pores, the entrances to a bony tube leading to the lower surface of the mandible near its tip. These channels continue posteriorly,

median to the lower edge of the rami of the mandible, passing through at least two pairs of ossified tunnels. Because of skin loss, it is impossible to determine whether or not this channel, after it emerges from the bone, is a completely enclosed tube; there are no remnants of such a tube between the ossified tunnels. The principal mandibular teeth are minute, depressible, needlelike and recurved, and form a band which decreases in width posteriorly.

The premaxillary teeth are minute, of about equal size, slightly recurved and depressible, and form a narrow band. Anteriorly this band is on the ventral surface of the premaxillary; posteriorly it is on the lateral face. The two lateral knobs of the vomer bear patches of stronger teeth, most of which are depressible. Though widely separated, these patches are continuous with one another, in most specimens, by way of a single row of minute teeth along the anterior edge of the vomer. The palatine teeth are very small and are restricted to a band along the anterior half of that bone.

The gill rakers on the first arch are flattened and of moderate length, that of the longest about equal to the diameter of the eye lens, and longer than the gill filaments opposing it. Rakers on second arch similar but much shorter; those on the last two reduced to spine-bearing knobs.

Predorsal distance 2.6–2.8 in standard length; preanal 1.2–1.4 in length; prepectoral 3.2–3.6 in length; preventral 2.3–2.5 in length. First three dorsal rays unbranched, the third longest; the depressed height of the fin 1.3–1.5 in length of head. First three anal rays unbranched, the third longest; the depressed height of anal fin

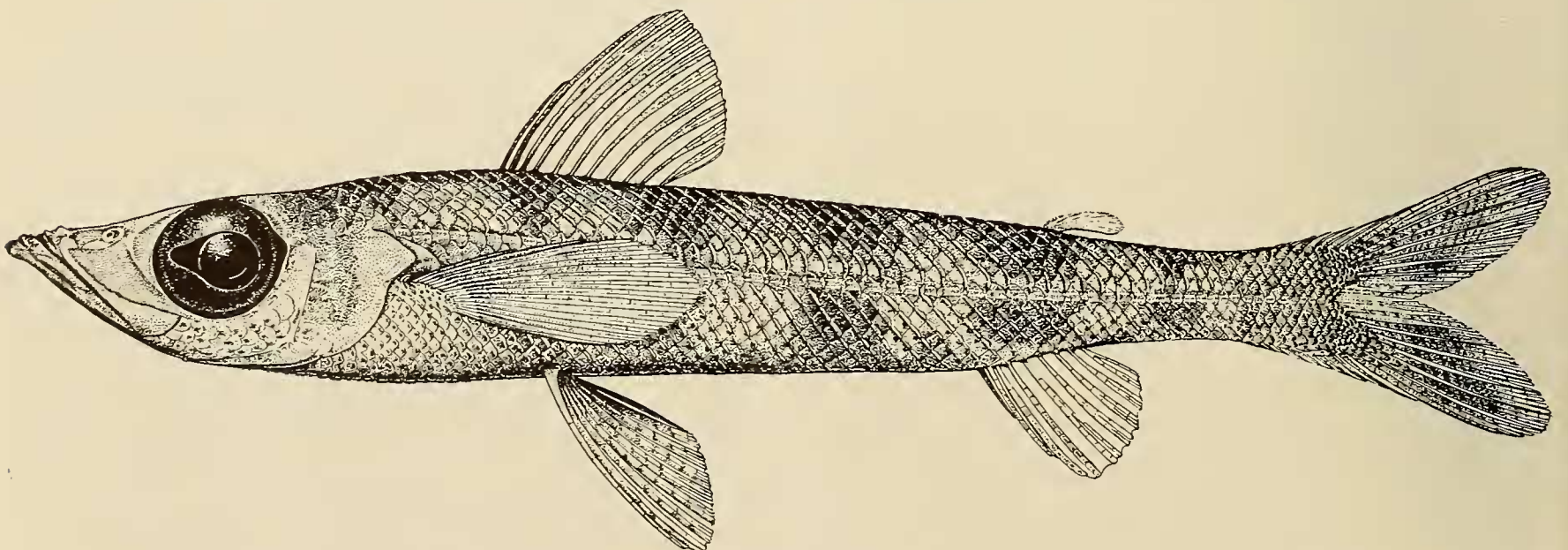


FIG. 1.—*Chlorophalmus brasiliensis*, holotype, 113.0 mm in standard length, U.S.N.M. no. 156892. (Drawn by Margaret G. Bradbury.)

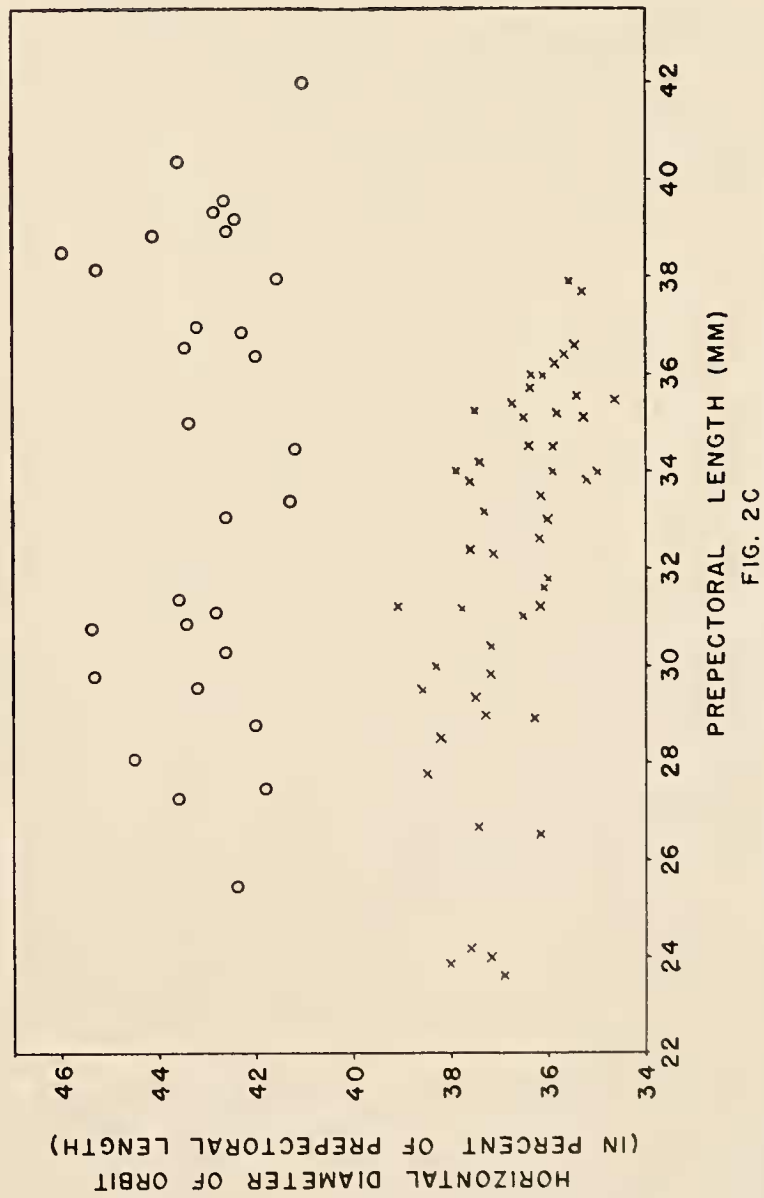
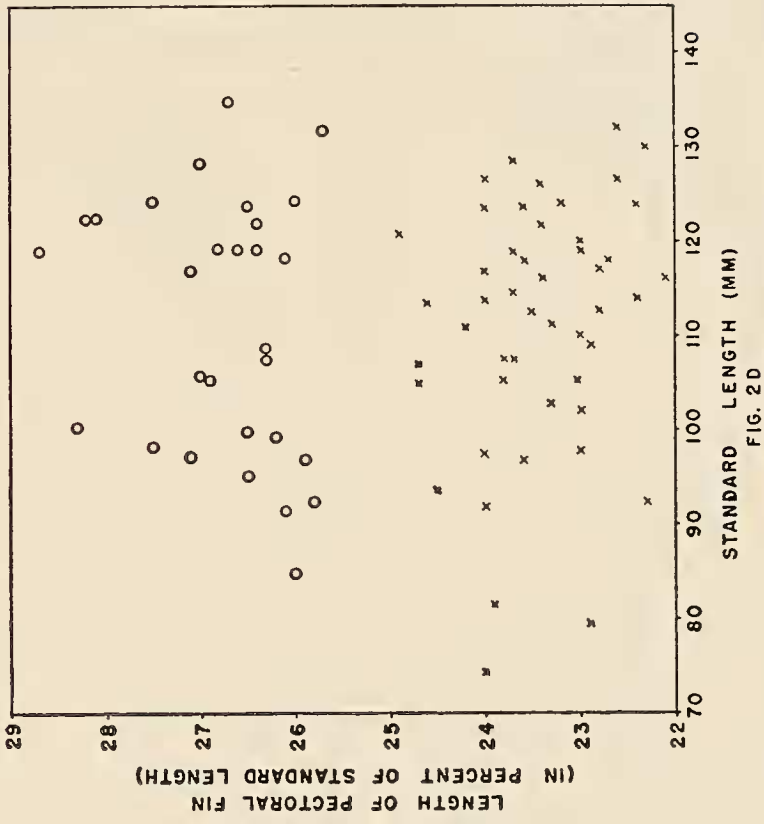
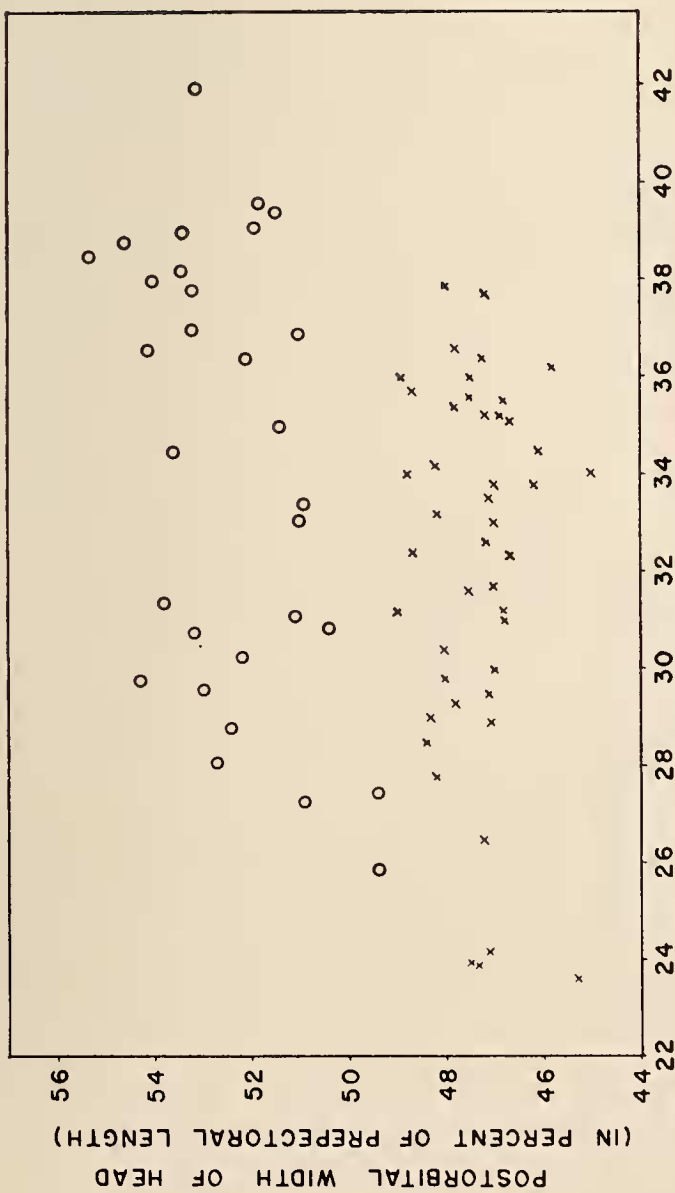
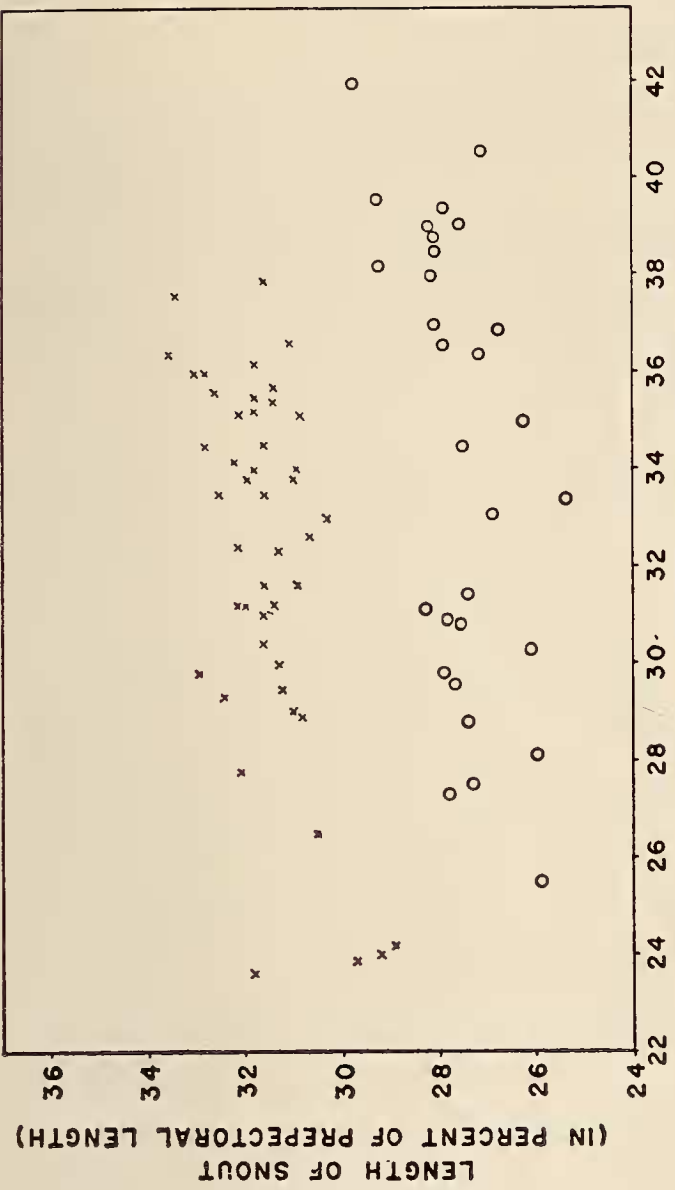


FIG. 2.—Morphometric comparison between *Chlorophthalmus brasiliensis* (X) and specimens of *C. agassizi* (O) from Venezuela, British Guiana, and Surinam: a, Ratio-on-size plot of postorbital width of head, in percent of prepectoral length, against prepectoral length; b, ratio-on-size plot of snout length, in percent of prepectoral length, against prepectoral length; c, ratio-on-size plot of horizontal diameter of orbit, in percent of prepectoral length, against prepectoral length; d, ratio-on-size plot of length of pectoral fin, in percent of standard length, against standard length.

2.0–2.2 in length of head. Length of pectoral fin 4.0–4.5 in body length; length of ventral fin 5.0–5.7 in length. Except for the bases of the caudal rays, all fins are scaleless.

Coloration.—In preservative, the background color of the body is yellowish or occasionally orange; it is nearly white ventrally, becoming brownish dorsally in fresh specimens. The irregular dark blotches below the midline are more prominent in young specimens. Broad vertical bands of variable width dorsally. Viewed from above, the most prominent of these are at the nape, each end of the dorsal fin base, midway between dorsal and adipose fins, just ahead of the adipose fin, midway between adipose fin and procurrent caudal rays, and through these procurrents. Narrower bands lie between these. The pattern, rather variable, fades with preservation in alcohol.

Tip of lower jaw and edge of upper jaw, operculum, linings of pharyngeal and abdominal cavities, eye and anus black. Snout and top of head dusky, suborbital and to a lesser extent ventral surface of head and body punctate.

A black stripe courses along the entire mid-dorsal line, but is most conspicuous between the nape and the origin of the dorsal fin. The scale rows are delineated by black lines. Fins dusky.

***Bathypterois (Bathypterois) bigelowi*, n. sp.**

Fig. 3

Bathypterois longipes (non-Günther), part, Goode and Bean, 1895: 66 (the juvenile recorded from Blake st. cxci).

Bathypterois quadrifilis (non-Günther), Longley and Hildebrand, 1941: 25.

Bathypterois (Bathypterois) bigelowi is represented in the collections of the Chicago Natural History Museum; University of Miami Marine Laboratory; the Museum of Comparative Zoology; and the United States National Museum. Although juveniles of this species have been present in the National Museum collection since the early exploratory activity of the Fish Commission steamer *Albatross*, the identity of these has not hitherto been appreciated and they have been variously referred to *Bathypterois longipes* and *B. quadrifilis*, species to which they bear a close but superficial resemblance. More recently, the western Caribbean exploration of the U. S. Fish and Wildlife

Service vessel *Oregon* (September, 1957) obtained large series of the new form, and it is now apparent that this species is the commonest bathypteroid in the western Atlantic and one which prefers waters much shallower than most of its congeners (260 to 400 fathoms).

Holotype.—A specimen 124.5 mm in standard length from the Caribbean Sea off Nicaragua, *Oregon* station 1915 (see data below); C.N.H.M. no. 64435.

Paratypes.—The following western North Atlantic specimens: 1 specimen, 90.6 mm (no precise data, western Caribbean), Chicago Natural History Museum no. 64422; 10, 88.0–117.0 mm, *Oregon* station 1906 (12° 19' N., 82° 27' W.; 325 fms.; Sept. 11, 1957), University of Miami Marine Laboratory no. 1998 and C.N.H.M. no. 64424; 4, 65.4–106.0 mm., *Oregon* station 1908 (12° 33' N., 82° 20' W.; 350 fms.; Sept. 11, 1957), C.N.H.M. no. 64426; 9, 80.3–120.5 mm, *Oregon* station 1909 (12° 35' N., 82° 19' W.; 350 fms.; Sept. 11, 1957), C.N.H.M. no. 64427; 1, 73.0 mm, *Oregon* station 1910 (12° 40' N., 82° 18' W.; 350 fms., Sept. 11, 1957), C.N.H.M. no. 64428; 1, 74.6 mm, *Oregon* station 1911 (12° 44' N., 82° 14' W.; 350 fms.; Sept. 11, 1957), C.N.H.M. no. 64429; 3, 119.0–123.6 mm, *Oregon* station 1912 (12° 49' N., 82° 15' W.; 325 fms.; Sept. 12, 1957), C.N.H.M. no. 64430; 1, 98.5 mm, *Oregon* station 1913 (12° 54' N., 82° 15' W.; 300 fms.; Sept. 12, 1957), C.N.H.M. no. 64431; 2, 98.8–123.0 mm, *Oregon* station 1914 (13° 06' N., 82° 13' W.; 350 fms.; Sept. 12, 1958), C.N.H.M. no. 64432; 15 (in addition to the holotype), 76.5–129.5 mm, *Oregon* station 1915 (13° 13' N., 82° 13' W.; 350 fms.; Sept. 12, 1957), C.N.H.M. no. 64459 and U.M.M.L. no. 1999 (1 sp.); 5, 105.1–126.6 mm, *Oregon* station 1917 (13° 20' N., 82° 02' W.; 325 fms.; Sept. 12, 1957), C.N.H.M. nos. 64436 and 64437; 6, 79.4–131.0 mm, *Oregon* station 1952 (16° 46' N., 82° 16' W.; 300 fms.; Sept. 17, 1957), U.M.M.L. no. 2335.

Seven additional specimens are available, all in very poor condition but undoubtedly referable to this species: 4, 45.0–71.5 mm, from south of Tortugas, Fla. (Longley; U.S.N.M. no. 117214 and C.N.H.M. no. 42784); 1, 81.5 mm, Johnson-Smithsonian Expedition, *Caroline* station 1.T.T.13, off the Virgin Islands (18° 33' 45" N., 65° 15' W.; 300–400 fms.; Jan. 30, 1933), U.S.N.M. no. 108292; 1, 137.6 mm, Johnson-Smithsonian Expedition, *Caroline* station 23

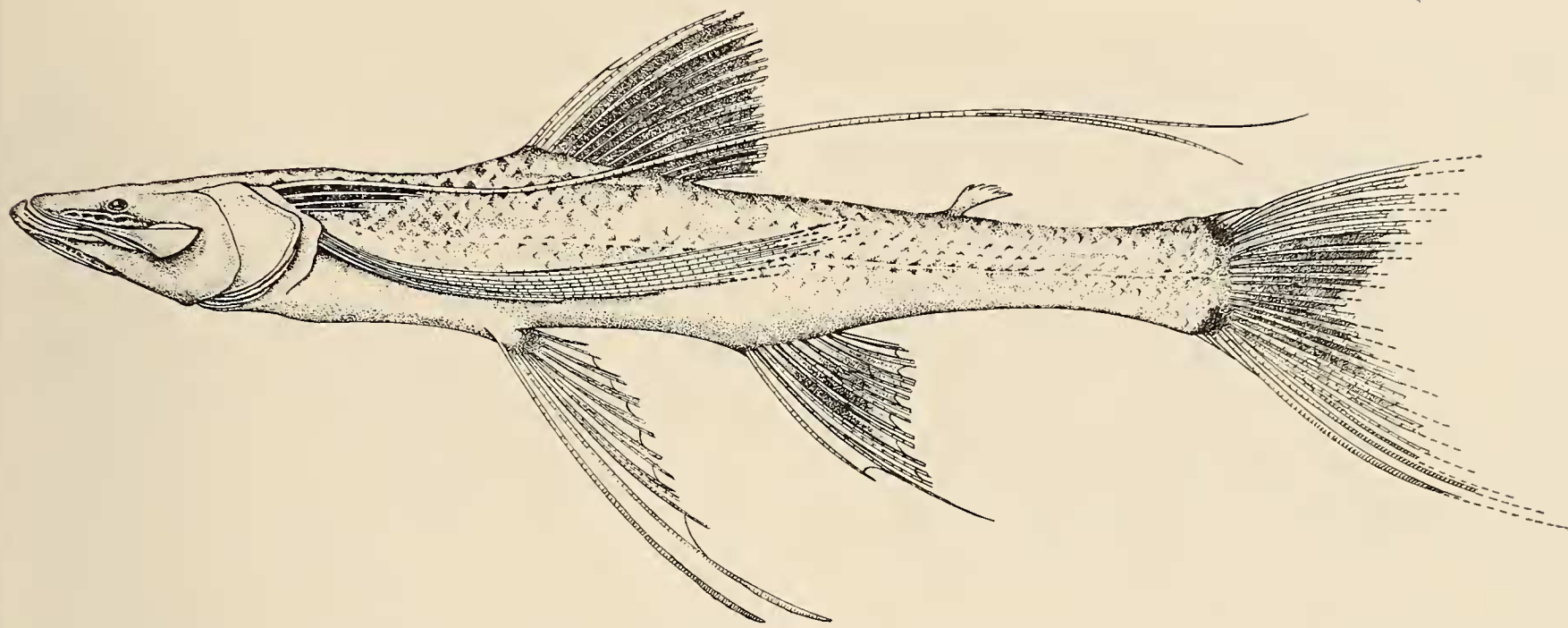


FIG. 3.—*Bathypterois bigelowi*. holotype, 124 mm in standard length, from the Caribbean Sea off Nicaragua; C.N.H.M. no. 64435. (Drawn by Mildred H. Carrington.)

T.T.113, off Puerto Rico ($18^{\circ} 32' N.$, $66^{\circ} 21' 45'' W.$; 260 fms; Feb. 4, 1933), U.S.N.M. no. 108261; 1, 49.2 mm, *Blake* station 191 ($25^{\circ} 33' N.$, $84^{\circ} 35' W.$), U.S.N.M. no. 47619, and 1, 89.0 mm long, which was caught at *Blake* station 154, off Monserat at 298 fms. (MCZ 27926).

Recently, the *Silver Bay* caught a single juvenile, 75.0 mm in standard length, in the Atlantic off central Florida at station 454 ($29^{\circ} 19' N.$, $79^{\circ} 58' W.$; 330 fms.; June 12, 1958). The principal characters of this fish fit the description of *B. (B.) bigelowi*, but in certain morphometric features, for example the relative length of head, this single specimen differs significantly. Since it was caught off the east coast of Florida while most *B. (B.) bigelowi* came from the Gulf of Mexico and Caribbean, it is excluded from the account given below. More Atlantic material is needed before a satisfactory comparison can be provided. This juvenile is now in the U. S. National Museum (no. 156951).

Diagnosis.—Body light in color (possibly greenish in life), darker dorsally than ventrally. Most of dorsal fin membrane black. Membrane between central caudal rays black. A prominent black spot at base of upper and lower caudal lobes. Membrane connecting lower rays of upper pectoral fin black.

Upper pectoral, outer ventral and lower caudal rays prolonged, the tips of the produced ventral and caudal rays typically thickened. Upper pectoral rays split at a point beyond origin of adipose fin. Eight ventral fin rays. Second or third anal ray considerably longer

than first or fourth. Usually three rays in upper pectoral fin below the uppermost two fused and prolonged rays (frequently four lower rays in upper pectoral fin in juveniles; occasionally two in adults). These lower rays well developed and connected by a black fin membrane. Usually 9 (8 to 10) rays in lower part of the pectoral fin, none notably stronger than the others. Dorsal fin situated over or behind a vertical from axil of ventral fin; anal origin well behind end of base of dorsal fin.

Lateral line scales 48 to 55, the lateral line continuing onto the caudal fin above central caudal ray. Scales behind lower part of pectoral fin base not pectinate. Total number of gill rakers on first arch 40 or fewer. Eye minute, its greatest measure much less than the width of the posterior end of the maxillary.

No notch below caudal peduncle (*cf. B. phenax*, the notch formed by the most posterior ventral procurrent caudal ray). Vertebrae 49 to 52.

Description.—The description which follows is based primarily on the type and ten additional specimens from various localities in the western Caribbean. Fin ray counts include all specimens. In the paragraph which follows, the proportional measurements taken from the type are followed, in parentheses, by the range of measurements found in ten paratypes. All are expressed in percent of standard length.

Length of head, 24.6 (20.9–24.1); length of snout, 8.3 (7.6–8.6); length of premaxillary, 15.6 (13.4–15.4). Horizontal diameter of eye, 1.4 (1.3–1.7); interorbital width, 8.5 (7.3–8.5).

Greatest depth of body, 15.5 (12.9–15.8);

depth at origin of anal fin, 13.7 (12.1–14.4); least depth of caudal peduncle, 8.3 (7.7–9.0). Greatest width of body, 8.8 (6.7–8.9).

Predorsal distance, 43.7 (40.0–45.0); preanal, 62.6 (57.6–62.0); prepectoral, 19.7 (17.8–21.8); preventral, 42.2 (37.3–42.1). Length of base of dorsal fin, 13.3 (11.5–13.2); of anal fin, 7.6 (6.4–8.3). Distance from base of last dorsal ray to adipose fin, 22.3 (21.6–23.9); from base of last anal ray to ventral procurrent caudal ray, 30.7 (30.0–34.7). Length of produced caudal ray, 28.5 (22.7–27.7); of longest pectoral ray, 96.6 (78.1–98.3); of longest ventral fin ray, 36.7 (29.1–37.2).

D.—12–13 (13 in 35 specimens, 12 in 17, 11 in 1). A.—9 (8 in 3, 9 in 44, 10 in 6). Lower rays in upper pectoral fin—3 (both fins of each specimen counted when possible: 2 in 9, 3 in 92, 4 in 5). Lower pectoral fin—9 (8 in 5, 9 in 74, 10 in 22). V.—8 (invariable). C.—I-16-II (invariable). B. R.—11 (infrequently 10 or 12). G. R.—10–12 + 1 + 22–28 = 33–40. Scales in lateral line—48–55. Vertebrae—(in 14 specimens from *Oregon* station 1915, western Caribbean),—49–52 (51 in 8 of these specimens).

Body compressed, snout depressed. Body deepest at origin of dorsal fin, 1.5 to 1.8 in length of head; depth at origin of anal fin 1.6 to 2.0 in head; least depth of caudal peduncle 2.5 to 3.1 in head.

Cheeks and body scaled; all scales cycloid. Lateral line complete, originating at upper point of gill opening and terminating on caudal fin above central caudal rays. Base of caudal fin scaled, all other fins naked.

Head 4.1 to 4.9 in standard length, nearly flat dorsally, rounded anteriorly but with a slight indentation at tip to receive symphyseal knob of lower jaw. Length of snout 2.8 to 3.3 in head. Top of head pierced by nostrils and a pair of longitudinal series of pores. Olfactory organ well developed, nostrils separated by a membrane which bears a short flap.

Eye small, horizontally elliptical and laterally directed, much smaller than greatest width of maxillary, 3.8 to 6.0 in length of snout. Eye relatively larger in juveniles. A horizontal row of about four pores below eye. Interorbital 2.7 to 3.0 in head length.

Branchiostegal membranes broad and free from isthmus, extending beyond rear edge of operculum but not reaching insertion of lower pectoral fin. Four branchiostegal rays on epi-

hyal; seven on ceratohyal. Opercular bones well developed and firm.

Gill rakers present on all four arches, spinulose, flattened; those near angle of first arch about twice the length of the opposing gill filaments.

Length of maxillary 1.6 to 1.8 in head, surmounted by a thin long supramaxillary which terminates anteriorly under rear edge of eye. Premaxillaries slender and separate from one another. Mandible heavy, its outer lower surface pierced by pores. A small edentulous symphyseal knob present. A band of minute teeth on premaxillary and mandible, both broader anteriorly. A small patch of minute teeth frequently but not always present on vomer, and an occasional row of very small teeth on palatine. Tongue toothless. Well developed patches of pharyngeal teeth.

Dorsal fin inserted well behind bases of inner ventral rays; predorsal distance 2.2 to 2.5 in standard length. First two dorsal rays simple, the rest branched. Adipose dorsal well-developed and broad, placed about equidistant from end of dorsal base and base of upper procurrent caudal rays. Anal inserted well behind a vertical from last dorsal ray; preanal distance 1.6 to 1.7 in body length. The first and occasionally the second anal ray simple, the second or third longer than its neighbors, markedly longer in most specimens than those in most bathypteroid species.

Lower two principal caudal rays simple and produced, their ends frequently slightly thickened. Lower branch of the branched ray immediately above the simple rays also elongated. The segments which form the lower simple rays and this lower branch of the first divided ray are much shorter than those of the caudal rays above them. These segments become shorter distally.

Two outer ventral fin rays simple and produced, extending beyond base of anal fin in adult. Distance between snout and insertion of ventral fin 2.4 to 2.7 in standard length. Upper two rays of pectoral fin united basally, separate distally, the split posterior to origin of adipose fin. Lower rays of upper pectoral fin well developed and connected by a black fin membrane. Usually four such rays in the juvenile but typically three in the adult. Lower pectoral rays (typically 9) well developed and stiffened, arching slightly upward, the longer extending

beyond end of base of dorsal fin. Lower pectoral rays about equal to one another in strength basally, Prepectoral distance 4.6 to 5.6 in standard length.

Coloration.—Living specimens are probably greenish in general body color. The background color of specimens preserved in alcohol is white, stippled below the midline by small black spots and darkened above by diffuse dark pigmentation in each scale pocket; the margin of each scale pocket is pigmentless. Head and ventral surface of body anterior to ventral fin darker. Mouth, branchiostegal membrane, and pharyngeal and abdominal cavities black. Lower pectoral fin and ventral fins colorless. Membranes connecting lower rays of upper part of pectoral fin, dorsal rays, and midcaudal rays black. A large conspicuous black spot at base of upper and lower caudal lobes.

Relationships.—*Bathypterois bigelowi* is unquestionably most closely related to *B. longifilis* Günther, a species which the *Challenger* dredged at 520 and 630 fathoms off the Kermadec Islands in the South Pacific. Both of these specimens were large females, about 13 inches long, and the species has not since been reported. *B. bigelowi* can be distinguished from Günther's species by the strong black pigment in the membrane which connects the lower rays of the upper part of the pectoral fin (colorless in *longifilis*), 9 or 10 rays in the lower pectoral fin (*cf.* 13), the greater length of the second anal ray, the total gill raker count (33–40 *cf.* 42), the presence of the large, conspicuous spots at the base of the caudal lobes and the general body coloration, and the more elongate outer ventral and lower caudal rays.

Bathypterois (Bathypterois) bigelowi cannot easily be confused with any other known North Atlantic bathypteroid species, a preliminary key to which follows below. In this key, *Bathypterois (Hemipterois) nigrescens* Parr is considered questionably distinct from *B. (H.) viridensis* Roule. *Bathypterois (Bathypterois) quadrifilis* has been described and figured as having no subcaudal notch (Günther, 1878: 184; Günther, 1887: 189, pl. 33; Goode and Bean, 1895: 65, fig. 75), but I have checked the Goode and Bean specimens, and Dr. N. B. Marshall has reexamined Günther's *Challenger* types; a subcaudal notch is present on all. *Bathypterois (Bathypterois) dubius* is probably polytypic.

KEY TO THE GENERA, SUBGENERA, AND NORTH ATLANTIC SPECIES OF BATHYPTEROID FISHES

- a. Pectoral fin divided into two distinctly different parts, the uppermost pectoral ray usually stiffened and elongate. Outer ventral and lower caudal rays frequently prolonged but never longer than the standard length of the fish. Adipose fin usually present (present in all known western Atlantic specimens).
 genus *Bathypterois*
- b. Uppermost pectoral ray not notably thicker at its base than its neighbor; all rays of upper part of pectoral well developed. Six or fewer rays in lower part of pectoral fin.
 subgenus *Bathypterois (Hemipterois)*
 B. (H.) viridensis Roule
 B. (H.) nigrescens Parr
- bb. Uppermost pectoral ray at least twice as thick as that of its neighbor. Lower rays of upper pectoral fin poorly developed. More than 6 rays in lower part of pectoral fin... subgenus *Bathypterois (Bathypterois)*
- c. Scales behind base of lower part of pectoral fin strongly pectinate. Lower ray of lower pectoral fin long and strong, conspicuously heavier at its base than its neighbor. Subcaudal notch present.
 B. (B.) quadrifilis Günther
- cc. Scales behind base of lower pectoral fin not pectinate. Lowermost ray of lower pectoral fin not notably thicker than its neighbor.
- d. Subcaudal notch present.
- e. Origin of anal fin behind a vertical from end of base of dorsal fin. Eight ventral rays... *B. (B.) dubius* Vaillant
- ee. Origin of anal fin under end of base of dorsal fin. Nine ventral rays.
 B. (B.) phenax Parr
- dd. No subcaudal notch.
- f. Lower rays of upper pectoral rudimentary and not connected by a black membrane. Interradial membrane of dorsal fin colorless. Body uniformly dark. Caudal lobes dusky but without conspicuous black spots at their bases. Central caudal rays colorless... *B. (B.) longipes* Günther
- ff. Lower rays of upper pectoral fin well developed, connected by a membrane which is black. Interradial membrane of dorsal fin black. Body darker above than below. A prominent black spot at bases of upper and lower caudal lobes. Membrane between central caudal rays black.
 B. (B.) bigelowi Mead
- aa. Pectoral fin not divided into two parts, the fin situated high on the shoulder and without greatly prolonged rays (none extend beyond anal fin). Outer ventral and lower caudal rays longer than standard length of fish. No adipose fin.
 Benthosaurus grillator Goode and Bean

Bathytyphlops marionae, n. sp.

Fig. 4

It is difficult to imagine a free-living fish more degenerate than the species of the genus *Bathytyphlops*. They are undoubtedly blind, for the eyes are vestigial and covered by skin and occasionally scales; and none of the other sensory structures are notably enlarged. They lack the elongate tactile rays of the bathypteroids, and the small villiform teeth and cephalic luminous organ of *Ipnops*. The "teeth" of *Bathytyphlops* consist of broad rugose grinding surfaces on most of the jaw and pharyngeal bones. These fishes cannot be active carnivores. But neither can they be filter feeders, for the gill rakers, normal and flattened in the related species of *Ipnops* and *Bathymicrops*, are reduced to low dentigerous rudiments. Only that at the angle of the gill arch is developed, this excessively so. They may perhaps be carrion feeders, although their relatively large (180–350 mm) size suggests nutritional requirements of some magnitude, and it seems unlikely that carcasses of sufficient size to warrant the large grinding surfaces are numerous in their habitat.

The specimens described below are the first *Bathytyphlops* known from the Atlantic. The single species heretofore described, *Bathytyphlops sewelli* (Norman) was caught in the Arabian Sea at a depth of 3840 to 3872 meters (Norman, 1939: 26) and from an unspecified *Galathea* station (Bruun, 1956: 171). These western Atlantic records thus extend the range of the genus half way around the world and, more significantly, into far shallower water, for the depths of capture here were 475 and 550 fathoms (868 and 1,000 meters).

It gives me pleasure to name this new and bizarre species in honor of Mrs. Marion Grey, Chicago Natural History Museum, in recognition of her contributions to the ichthyology of the deep sea.

Holotype.—A 279.0 mm specimen caught in the Caribbean at *Oregon* station 1955 (16° 48' N., 82° 33' W.; 550 fathoms; Sept. 17, 1957); Chicago Natural History Museum no. 64439.

Paratype.—A specimen 263.0 mm long taken by the Harvard-Havana Expedition at *Atlantis* station 2991 (Strait of Florida north of Cuba; 23° 21' N., 80° 23' W.; 475 fathoms; March 14, 1938; Museum of Comparative Zoology no. 39394).

Diagnosis.—Eye present, minute but pigmented and with a well-developed lens; covered by skin but not scales. Pectoral fin 12 or 13; dorsal 12 or 13; anal 13–14. 64 or 65 scales in lateral line.

Description.—The proportional measurements which follow, expressed in percent of standard length, are those of the type, 279.0 mm, followed in parentheses by those of the 263.0 mm specimen (paratype):

Length of head, 23.1 (22.4); length of snout, 7.5 (6.6); of premaxillary, 17.0 (16.6); diameter of eye (horizontal): .7 (.8); width of interorbital, 8.6 (8.5).

Greatest depth of body, 16.0 (—); depth at origin of anal fin, 10.3 (9.9); least depth of caudal peduncle, 7.7 (7.2). Greatest width of body, 9.4 (9.8).

Distance from snout to origin of dorsal fin, 39.1 (40.3); to origin of anal fin, 69.6 (69.0); to insertion of pectoral fin, 21.3 (21.7); to insertion of ventral fin, 37.5 (37.9). Length of base of dorsal fin, 12.7 (12.2); length of base of anal fin, 14.0 (12.4). Anus to insertion of ventral fin, 10.8 (—); to origin of anal fin, 22.0 (—).

Distance from insertion of ventral fin to origin of anal fin, 32.4 (33.2); from end of base of dorsal fin to that of midcaudal ray, 47.5 (48.3); from end of anal base to base of midcaudal ray, 17.6 (17.5). Depressed height of dorsal fin, 21.7 (20.1); of anal fin, 19.4 (17.2). Length of central caudal ray, 8.6 (10.4); length of pectoral, 20.1 (17.1); of ventral, 16.7 (15.4).

D.—12–13. A.—13–14. P.—12–13. V.—8. C.—I-17-I. B.R.—15–17. Scales (lateral line)—64–65; from D. to lateral line—8; from 1.1. to A.—6. Vertebrae (including hypural)—63–64.

Body moderately compressed, snout somewhat depressed. Body deepest at origin of dorsal fin, this depth about 1.4 in head length, about 6.2 in standard length. Depth at anal origin 2.2 to 2.3 in head; least depth of caudal peduncle 3.0 to 3.1 in head. Greatest width of body about 1.7 in greatest depth.

Entire top of head, cheeks, anterior part of branchiostegal membrane and gular membrane, entire body, and base of caudal rays scaled, the scales (as well as can be determined) cycloid, deciduous. (Few scales remain on the two study specimens.) A broad sheath of scales extending across venter between (and partly covering) bases of inner ventral rays. An enlarged rounded scale in axil of pectoral fin, and rows of more

elongate scales along bases of dorsal and anal fins. Lateral line well developed, the scales pierced by a longitudinal tube which also opens above and below. Lateral line begins above base of pectoral fin and ends at base of caudal; it does not continue onto the caudal fin.

Head of moderate size, the lower jaw terminal. Head 4.3 to 4.5 in standard length. Rear margin of head formed by the branchiostegal membrane, the rear border of the head (edge of gill cover) sloping obliquely downward and backward; the most posterior point below the posterior half of the base of the pectoral fin. Top of head covered by skin and scales, the head bones well ossified, the ankyloses poorly developed. Olfactory organs well developed, slightly closer to tip of snout than to eye. A thin tube around anterior nostril, this tube enlarged into a flap posteriorly between the nostrils. Behind each posterior nostril are a pair of slits which do not communicate with the olfactory cavity; the function of these is not apparent. Top of head without the ossified pores characteristic of many related species. Eye minute, covered by skin but apparently not scaled over. A few poorly ossified circumorbital bones floating free in skin around eye. Interorbital width 2.6 to 2.7 in length of head.

Branchiostegal membranes broad, free from isthmus and from each other, the left overlapping the right. Isthmus relatively broad and scaled. Branchiostegal membranes scaled, covered anteriorly by a thick, broad and scaled transverse gular fold. Branchiostegal rays well developed, the uppermost not notably flattened. Opercular bones large and well ossified, the

operculum ending posteriorly with the well-developed suboperculum.

Gill rakers on first arch consist of one large heavy raker at angle, the length of which is equal to the distance between the nostrils, and basal ossifications (about 6 on the epibranchial, 12 to 14 on the ceratobranchial) which represent rudimentary rakers. These rudiments, the edges of the branchial bones, and the enlarged raker at the angle are covered by minute short spines which provide a rugose surface similar to the tooth patches on jaws and vomer. The succeeding arches bear similar rugose patches, and the pharyngeals are completely covered with patches of similar although larger teeth.

Premaxillary long and slender, 1.3 to 1.4 in length of head. Lower and outer surface completely covered with denticles, giving the bone a rugose appearance. Maxillary slender for most of its length when viewed from the side, but expanded in the horizontal plane. Posteriorly, the maxillary is expanded vertically and surmounted by an irregularly-shaped supramaxillary. A short fleshy flap at posterior end of maxillary. No teeth at symphysis of either jaw. Palatine, pterygoid and vomerine teeth similar, the toothed patches large. The two tooth-bearing patches on vomer separated by a deep trough. Mandible broad and heavy, its outer lower surface pierced by the series of pores characteristic of many deep-water inioforms. Lower edges of mandibles well separated from one another (in contrast to the situation in the bathypteroids, in which the lower edges of the dentaries very nearly meet along the mid-ventral line). Articular bone exceptionally long, extending for-

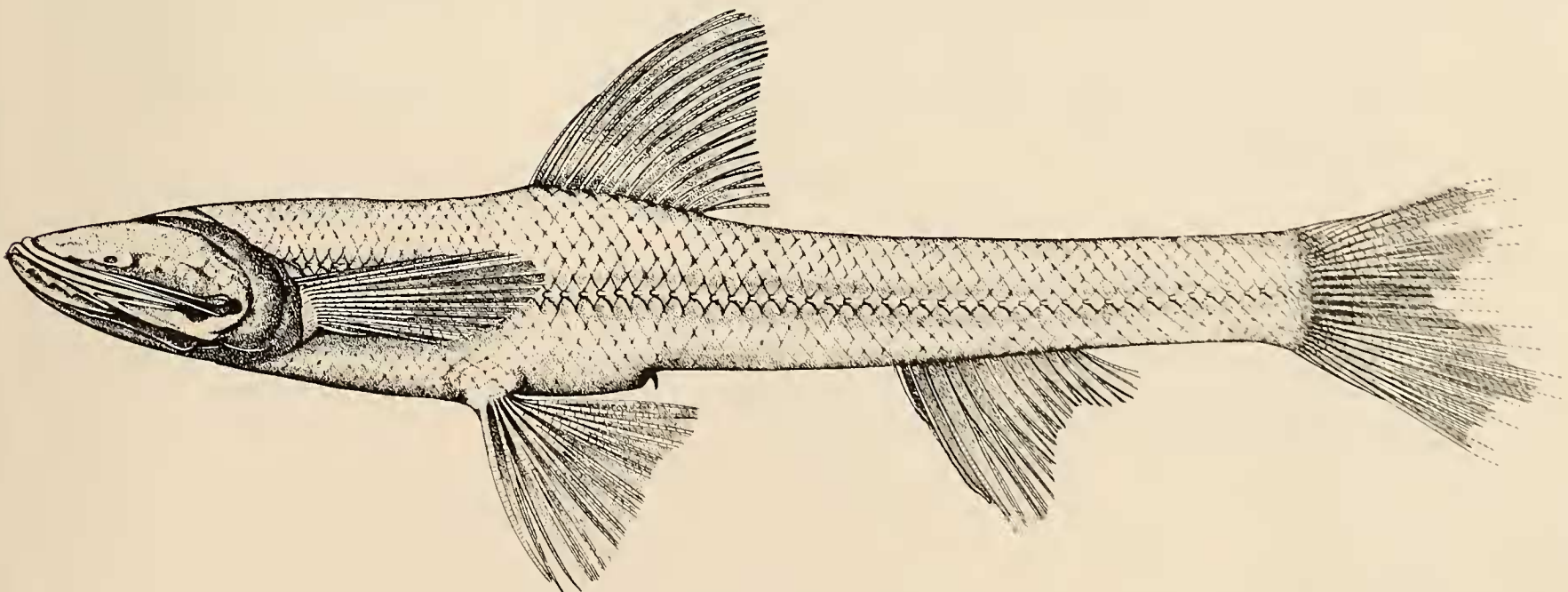


FIG. 4.—*Bakhytyphlops marionae*, holotype, 279 mm in standard length, from the Gulf of Mexico off Florida; C.N.H.M. no. 64439. (Drawn by Mildred H. Carrington.)

ward half the distance from joint of mandible to tip of lower jaw. Mandible ending anteriorly in a small knob. Symphysis without teeth, the rest of the upper surface covered with the molariform denticles characteristic of the other tooth-bearing bones of the mouth.

Dorsal fin inserted just behind a vertical from insertion of ventral; predorsal distance 2.5 to 2.6 in standard length. First two dorsal rays simple, the rest branched, the last to its base. Distance from dorsal origin to tip of fin when fin depressed 4.6 to 5.0 in standard length; length of base of dorsal fin about 1.8 in head length. Anal origin posterior, preanal distance 1.4 to 1.7 in standard length; distance between end of base of anal fin and base of midcaudal ray about 5.7 in standard length. Height of anal fin (depressed) 1.2 to 1.3 in head length. Two or three rays simple, the remainder branched. Caudal fin forked, the lobes equal.

Prepectoral distance 4.6 to 4.7 in standard length. Fin extending to base of ventral fin, its length 1.1 to 1.3 in length of head. Uppermost two and lower two rays simple. Pre-ventral distance 2.6 to 2.7 in standard length, the outer ray only unbranched. Length of ventral fin 1.4 to 1.5 in length of head. Anus about a third of the distance from insertion of ventral fin to origin of anal.

Color.—In alcohol, *B. marionae* is light with dark edges around the scale pockets (the body may be wholly dark when the animal is alive and with its skin and scales intact). Head dark. Branchiostegal membrane, fins, and linings of body cavities black.

Relationship.—*Bathytrophops marionae* is very closely related to the Indian Ocean *B. sewelli*, differing from it in some body propor-

tions and in the features given in the diagnosis above. Dr. N. B. Marshall has generously re-examined the type specimen in my behalf, and his comments on the gill raker structure and eyes of this specimen are noted here since they were omitted from the original account provided by Norman. Dr. Marshall reports that there is an enlarged gill raker (5.5 mm) at the angle of the first gill arch, the rest of the rakers being rudimentary and the gill raker count: 6 + 1 + 11. The eye rudiment is not absent but is barely visible beneath the skin. Its diameter is about 1.5 mm, and there is a narrow pigmented ring around the opaque center. In gill raker structure, *B. sewelli* is thus similar to *B. marionae*. The vestigial eye of *B. marionae*, about 2.5 mm in diameter in the 279-mm type, is rather larger than that in Norman's 350-mm specimen.

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The new powers that science has given to man can only be wielded safely by those who, whether through study of history or through their own experience of life, have acquired some reverence for human feelings and some tenderness toward the emotions that give color to the daily existence of men and women.—BERTRAND RUSSELL.